A DISSERTATION ON

FEMORAL CORTICAL BONE HOMOGRAFT OSSICULO PLASTY

M.S. Degree (Branch IV)

OTO RHINO LARYNGOLOGY

THE TAMILNADU

DR.M.G.R. MEDICAL UNIVERSITY

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CERTIFICATE

This is to certify that this dissertation entitled "**FEMORAL CORTICAL BONE HOMOGRAFT OSSICULO PLASTY**" submitted by DR.C. BALASUBRAMANIAN to the faculty of OTORHINO LARYNGOLOGY, The Tamil Nadu Dr. M.G.R. Medical University, Chennai, in partial fulfilment of the requirement in the award of degree of M.S.Degree, Branch – IV (OTO - RHINO LARYNGOLOGY), for the August 2006 examination is a bonafide research work carried out by him under our direct supervision and guidance.

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DECLARATION

I, Dr. C. BALASUBRAMANIAN declare that the dissertation titled "**FEMORAL CORTICAL BONE HOMOGRAFT OSSICULO PLASTY**" has been prepared by me.

This is submitted to The Tamil Nadu Dr. M.G.R. Medical University, Chennai, in partial fulfilment of the requirement for the award of M.S.Degree,Branch IV(OTO - RHINO LARYNGOLOGY) degree Examination to be held in AUGUST 2006.

Place : Madurai

Date : **Dr. C. BALASUBRAMANIAN**

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CONTENTS

INTRODUCTION

INTRODUCTION

Chronic supprative otitis media of unsafe type as its common presenting future can produce hearing disability. The hearing defect usually occurs due to ossicular interruption.

In the past, very many types of bio materials and alloplastic prostheses were used for ossicular reconstruction. The end result of bio materials and alloplastic prostheses regarding stability of hearing is inferior to that of auto or homograft ossicles. So there is immense demand to have an ossicular bank with auto and homograft ossicles.

In this prospective study, we used femoral cortical bone homo graft ossicle for ossicular reconstruction. Long term result has to be tested in time future.

AIM OF THE STUDY

AIM

- A comprehensive study of ossicular chain reconstruction with femoral cortical bone homograft
- To analyze the stability of femoral cortical bone homograft
- To analyze the hearing improvement with femoral cortical bone homograft

REVIEW OF LITERATURE

DEVELOPMENT OF THE MIDDLE EAR OSSICLES

The cavity and the lining of the middle ear cleft and eustachian tube arise from the expanding first pharyngeal pouch with probably some contribution at the medial end from the second.

The outer lateral ends of the first (Meckel's) and second (Reichert's) arch cartilages lie, respectively, above and below the developing first pharyngeal pouch. Before these arch cartilages are fully defined, condensations in the mesenchyme appear in this region at about fifth week. As development proceeds, the condensations form cartilage models which, by sixth week, are well – defined as malleus, incus, stapes.

By fifth week, the stapes can be recognized as a circular mass at the end of the precursor of Reichert's (second arch) cartilage. Approximately two weeks later, this becomes annular as it is pierced by the first arch (stapedial) artery, and is now attached to the developing Reichert's cartilage by a membranous bar, the interhyale.

At this time, the malleus and incus are developing from cartilage at the end of the precursor of Meckel's (first arch) cartilage. A groove represents the site of the future incudomalleolar joint, and the handle of the malleus and long process of incus are already apparent. By seventh week, the handle of the malleus lies between the layers of the developing tympanic membrane.

The stapes continues to grow and its ring – like shape is converted into the definitive arch like stapedial form. It seems likely that the foot plate of the stapes is formed primarily from the otic capsule and that part of the stapedial ring which fuses with the otic capsule during ossification usually regresses. In the adult, therefore, the stapedial arches are derived from second arch cartilage, while the footplate is part of the labyrinthine capsule.

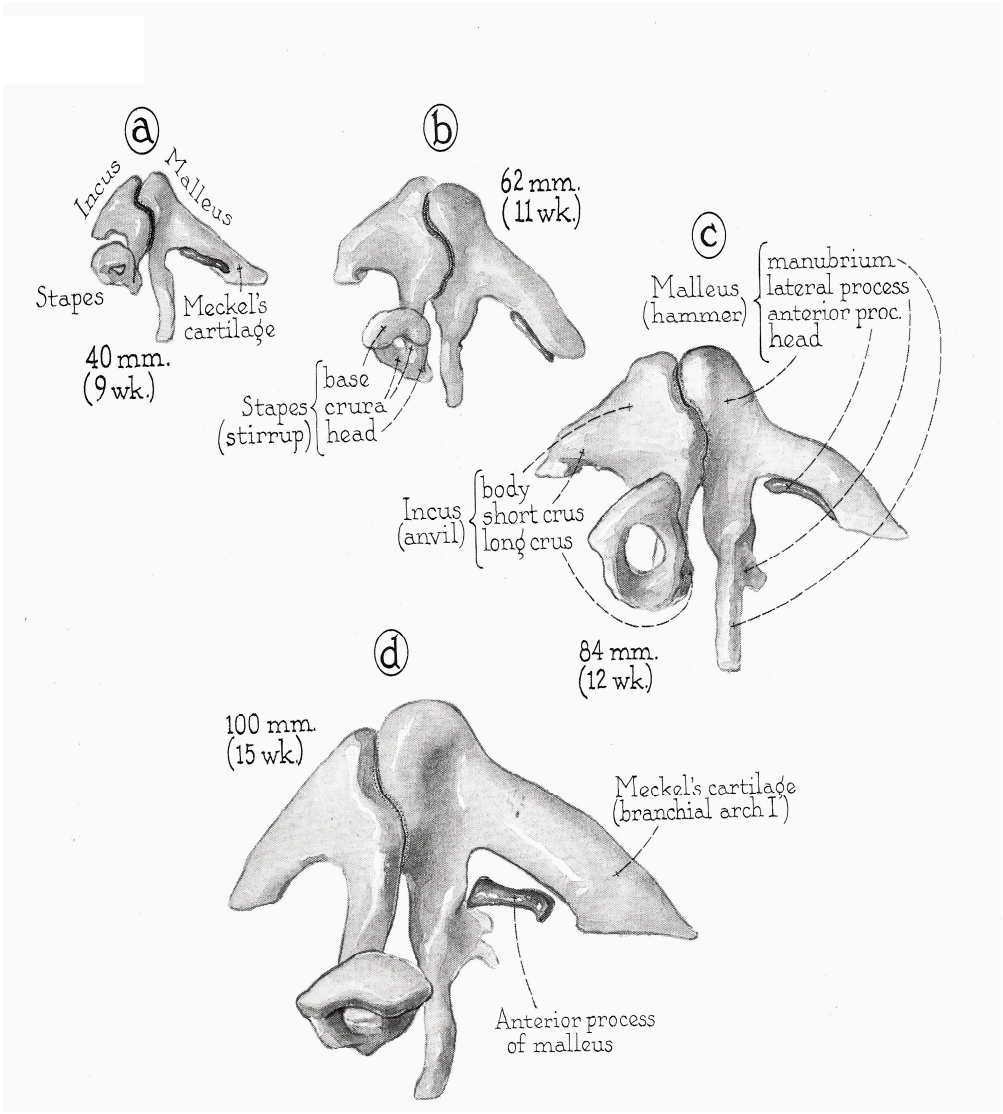
Frequently, however, regression of the base of the stapedial ring is incomplete so that a dual origin for the mature foot plate is possible. Ossification in the stapedial cartilage starts from a single centre at fifth month and is followed by a complex pattern of

resorption, with the result that the base, the crura and the adjoining head are eventually hollowed out. The malleus and incus start ossifying at the fourth month stage and progress is so rapid that, in the twenty-fifth week fetus, they are already of adult size and form.

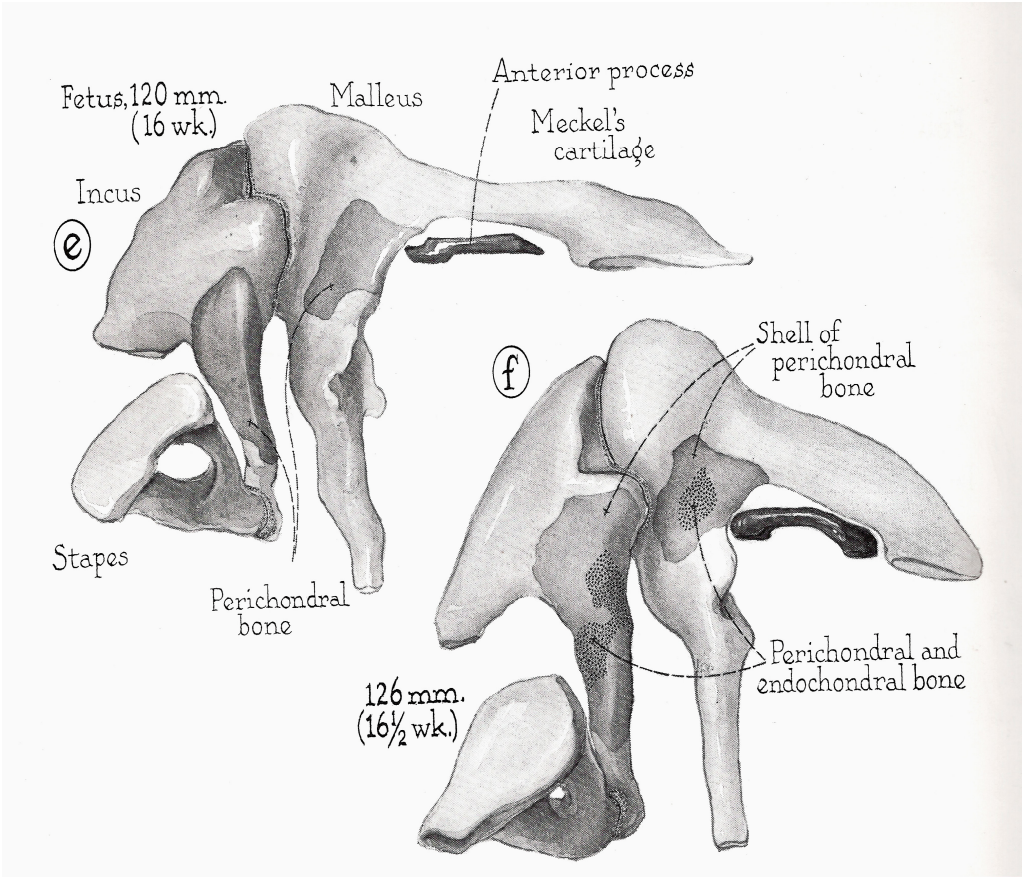
A centre of ossification first appears on the anterior surface of the long process of the incus and spreads in an encircling movement, the short process being the last to be invested with bone. The malleus next exhibits a small plaque of bone on the medial surface of the body near the area of articulation with the incus, from which centre of ossification bone spreads upwards over the body and downwards over the handle.

Last to ossify is the stapes. From a single centre appearing in the tympanic surface of the footplate, bone spreads along each crus towards the head. Ossification of the stapes is accompanied by complicated remodeling. The stapes has attained its full size by the 20^{th} week increase being limited by cessation of periosteal growth once the crura are encircled and by the absence second epiphyseal centres.

DEVELOPMENT OF OSSICLES



DEVELOPMENT OF OSSICLES



Fetal week	
8th	Incus and malleus present in cartilage
15th	Cartilaginous stapes formed
16th	Ossifications of malleus and incus begins
18th	Stapes begins to ossify
32nd	Malleus and incus complete ossification
37th	Stapes continuous to develop until adulthood

ANATOMY OF THE MIDDLE EAR OSSICLES

The tympanic cavity is an irregular, air filled space within the temporal bone and contains the auditory ossicles and their attached muscles.

The cavity contains a chain of three small movable bones – the malleus, incus and stapes, two muscles, the chorda tympani nerve and the tympanic plexus of nerves.

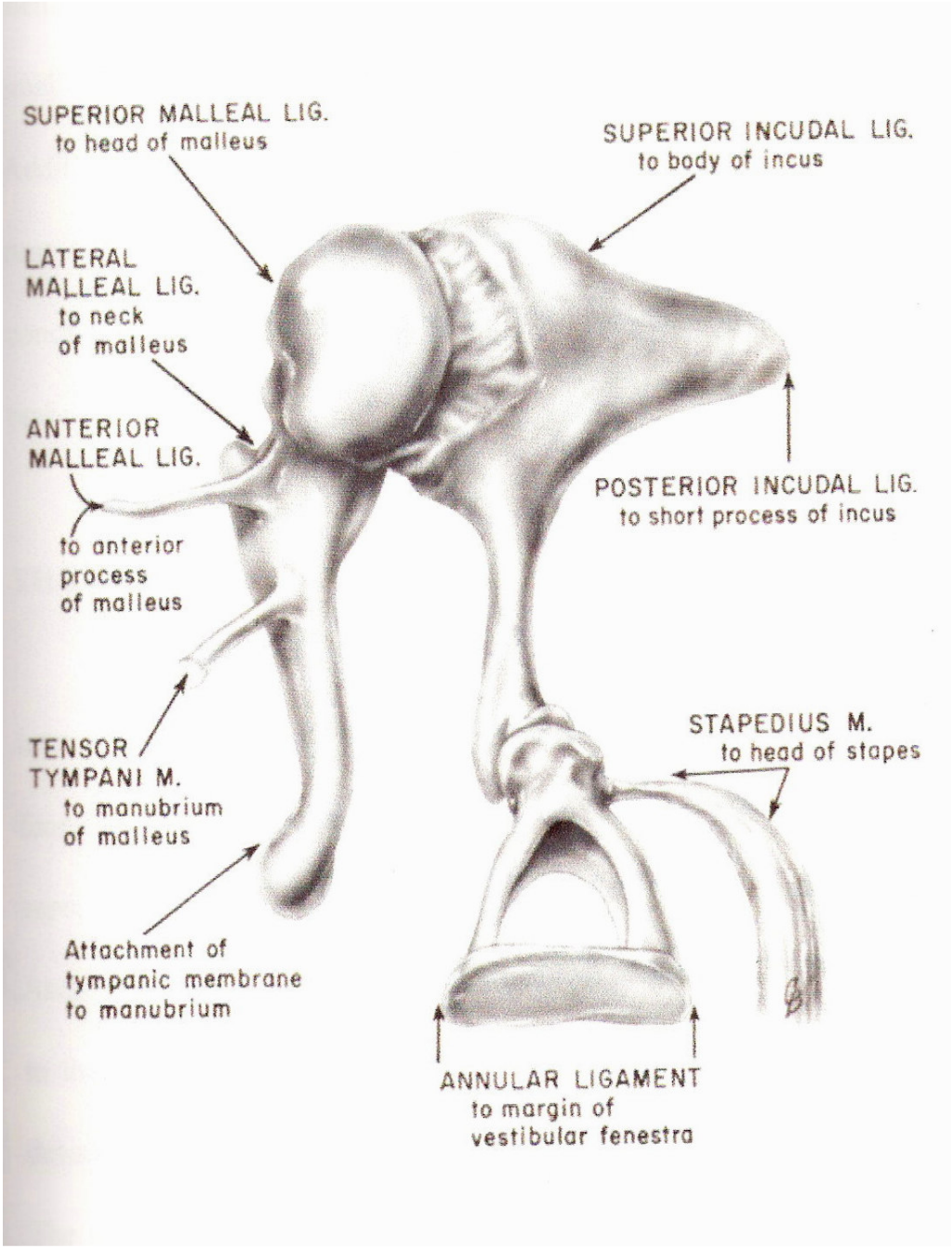
THE MALLEUS :

The malleus (hammer), the largest of the three ossicles, comprises a head, neck and three processes arising from below the neck. The overall length of the malleus ranges from 7.5 to 9.0 mm. The head lies in the epitympanum and has on its posteromedial surface an elongated saddle shaped, cartilage covered facet for articulation with the incus.

This surface is constricted near its middle and the smaller inferior portion of the joint surface lies nearly at right angles to the superior portion. This projecting lower part is the cog, or spur, of the malleus. Below the neck of the malleus, the bone broadens and gives rise to the following , the anterior process from which a slender anterior ligament arises to insert into the petrotympanic fissure; the lateral process which receives the anterior and posterior malleolar folds from the tympanic annulus ; and the handle.

The handle runs downwards, medially slightly backwards between the mucosal and fibrous layers of the tympanic membrane. On the deep, medial surface of the handle, near its upper end, is a small projection into which the tendon of the tensor tympani muscle inserts. Additional support for the malleus comes from the superior ligament which runs from the head to the tegmen tympani.

AUDITORY OSSICLES



THE INCUS :

The incus articulates with the malleus and has a body and two processes. The body lies in the epitympanum and has a cartilage-covered facet corresponding to that on the malleus. The short process projects backwards from the body to lie in the fossa incudis to which it is attached by a short ligament. The long process descends into the mesotympanum behind and medial to the handle of the malleus, and at its tip is a small medially directed lenticular process which articulates with the stapes.

THE STAPES :

The stapes consist of a head, neck, two crura (limbs) and a base or foot plate. The head points laterally and has a small cartilage – covered depression for articulation with the lenticular process of the incus.

The stapedius tendon inserts into the posterior part of the neck and upper portion of the posterior crus. The two crura arise from the broader lower part of the neck and the anterior crus is thinner and less curved than the posterior one. Both are hollowed out on their

concave surfaces. The two crura join the footplate which usually has a convex superior margin, an almost straight inferior margin and curved anterior and posterior ends. The average dimension of the foot plate are 3 mm long and 1.4 mm wide, and it lies in the fenestra vestibule where it is attached to the bony margins of the labyrinthine capsule by the annular ligament. The long axis of the foot plate is almost horizontal with the posterior end being slightly lower than the anterior.

THE BLOOD SUPPLY :

Arteries supplying the walls and contents of the tympanic cavity arise from both the internal and external carotid system. A major contribution to the supply of the stapes and incudo-stapedial joint comes from a plexus of vessels derived from the stylomastoid artery and which surrounds the facial nerve to enter the tympanic cavity by way of the pyramid or directly through its posterior wall. Additional vessel reaches the stapes from the main work of arterioles on the promontory, and probably derive mainly from the anterior and inferior tympanic arteries.

Average Dimensions

Malleus

Weight - 23 mg

Length - 7.6 - 9.1 mm

Incus

Weight - 25-30 mg

Length of Long process of incus - 7 mm

Stapes

Weight - 2.86 mm

Height - 3.26 mm

Foot Plate

Length - 2.64 – 3.37

Width - 1.41

PHYSIOLOGY OF THE MIDDLE EAR

The transformer of the middle ear although working as a complex whole, may be divided into three stages.

1. That provided by the ear drum,
2. That provided by the ossicles
3. That provided by the difference in area between the TM and the stapes footplate

CATENARY LEVER :

The curved membrane of the drum head acted as a catenary lever, which, when stretched, exerts greater force upon its point of attachment. Because the fibrous annulus is immobile, sound energy applied to the tympanic membrane is amplified at its central attachment, the malleus.

OSSICULAR LEVER :

The malleus and incus acting as a unit rotating around an axis running between the anterior malleolar ligament and the incudal ligament. This lever ratio averages 1.3 to in human. The catenary and ossicular levers acting in concert provide an advantage of 2.3 more than twice that of the ossicular acting alone.

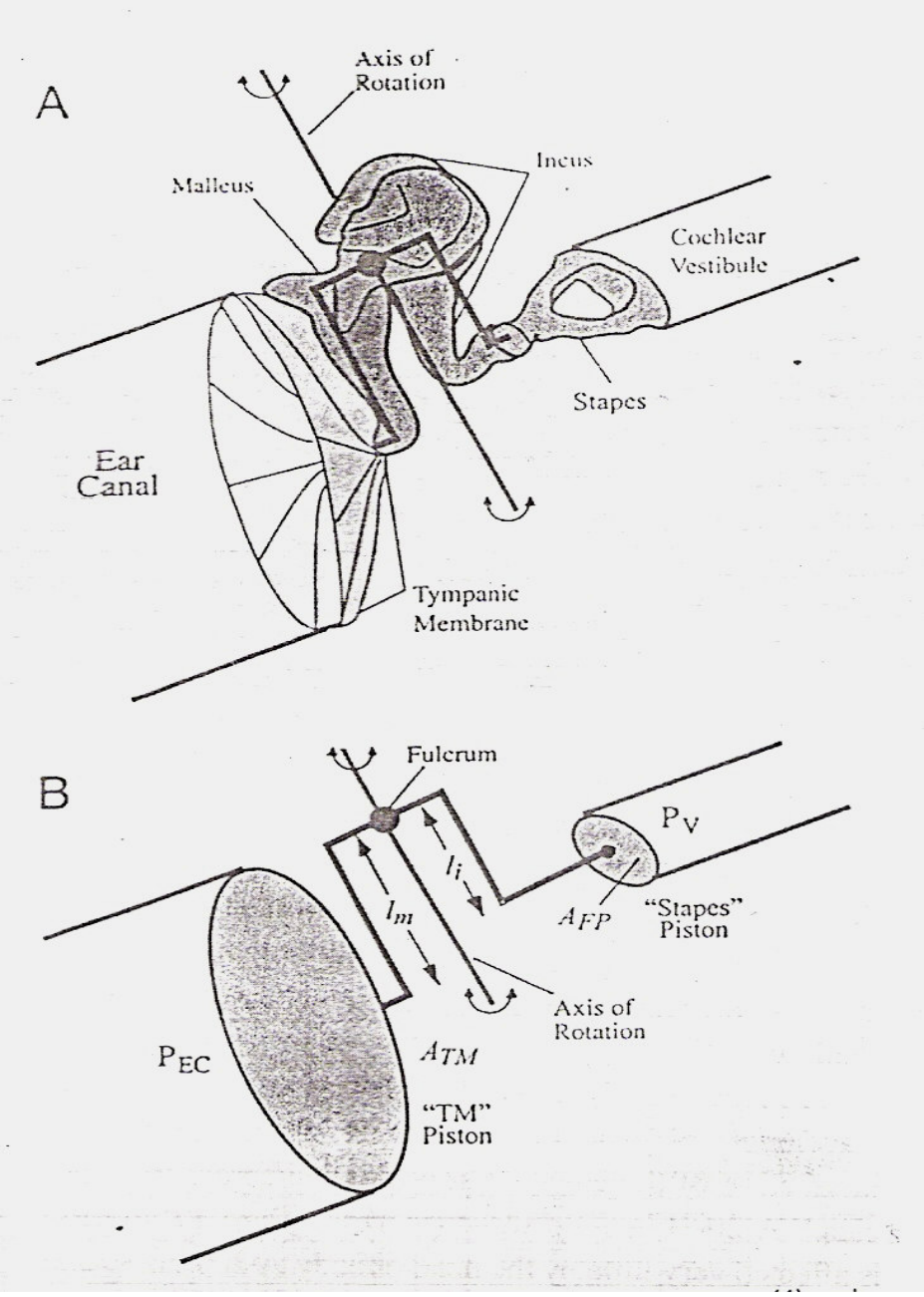
HYDRAULIC LEVER :

Sound pressure collected over the large area of the tympanic membrane and transmitted to the smaller footplate area results in an increase in force proportional to the ratio of the area.

A summary of the concepts of the middle ear transformer :

1.	Catenary lever	Force acting on TM / Force acting on malleus	2.0
2.	Ossicular lever	Force acting on malleus / Force acting on stapes	1.15
3.	Areal ratio	Area of TM / Area of footplate	21.0
4.	Total lever advantage	Force acting on foot plate / Force acting on TM	48.3 34.0db

TRANSFORMATION OF SOUND



Bone Conduction :

The internal component of bone conduction is due to the lag of the conduction apparatus in following the vibration of the skull, thus creating a relative movement of the stapes on oval window. This movement is important between 500 and 2000 Hz. Fixation or interruption of the ossicular chain reduces this energy transfer and causes falsely depressed scores on bone conduction testing.

The middle ear acts as a low – pass filter, allowing frequencies below the network resistance of 1000 Hz to pass while attenuating higher freqeuencies at a 16dB octave slope.

PATHOLOGY OF CHRONIC SUPPURATIVE OTITIS MEDIA

Chronic suppurative otitis media is a very different disease, not only in the duration of the discharge but even more in the etiology, in the pathologic changes in the ear, an in the clinical course. Therefore, pathological definitions are increasingly being used in preference to anatomical ones.

Pathological Classification

1. Inactive mucosal chronic otitis media
2. Active mucosal chronic otitis media
3. Active squamous epithelial chronic otitis media
4. Inactive squamous epithelial chronic otitis media
5. Healed otitis media
6.

1. INACTIVE MUCOSAL CHRONIC OTITIS MEDIA :

Here there is a permanent defect of the pars tensa but there is currently no evidence of inflammation either of the middle ear mucosa or tympanic membrane.

The ossicular chain may be eroded or fixed. The natural history of such an ear is to become active or remain inactive.

ACTIVE MUCOSAL CHRONIC OTITIS MEDIA :

In addition to the tympanic membrane defect the middle ear mucosa is inflamed and edematous with the production of excess mucus or mucopus. Such activity may be continuous or intermittent. In some ears, granulation tissue or polyp can develop.

ACTIVE SQUAMOUS EPITHELIAL CHRONIC OTITIS MEDIA :

Here in addition to active mucosal chronic otitis media, there is a squamous epithelially lines pocket full of squamous epithelium and inflammatory debris. This most frequently arises in the pars flaccida but can occur from pars tensa retraction pocket.

INACTIVE SQUAMOUS EPITHELIAL CHRONIC OTITIS MEDIA :

Various degrees of retraction of the both pars flaccida and tensa must be considered normal but when part of the retraction is

out of vision, this is considered abnormal because of its potential to retain squamous epithelial debris which might lead to active squamous epithelial diseases, cholesteatoma.

HEALED OTITIS MEDIA :

Here the pars tensa and pars flacida are intact and normal in position but in abnormal appearance. This may be due to various degrees of scarring thickening, chalk patches, tympanosclerotic plaques or healed perforations.

Such an ear is burnt out with regard to activity and, disability, if any, will be a hearing impairment due to ossicular chain fixation or disruption. In addition, there are many ears that if looked at histologically, will have evidence of old otitis but the tympanic membrane is normal.

PATHOLOGY OF OSSICULAR EROSION

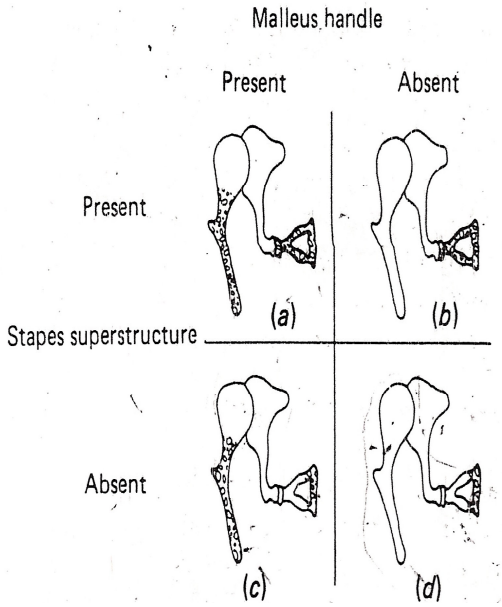
Ossicular chain erosion occurs in ears with or without cholesteatoma. In most instances the erosion is a result of non-specific hyperaemia associated with mucosal inflammation.

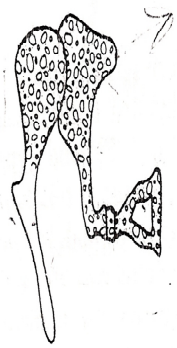
The long process of the incus and the stapes superstructure are the parts of the chain which are most frequently affected, is likely to be due to their delicate structure rather than their tenous blood supply.

The proposed mechanism of bone erosion in cholesteatoma and chronic otitis media are

1. Chemical dissolution,
2. Ischaemic necrosis
3. Enzymatic bone absorption.

AUSTIN'S CLASSIFICATION

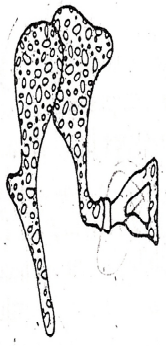




(e)

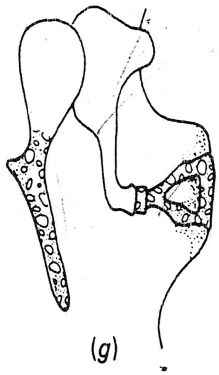
Malleus handle absent

(ii)



(f)

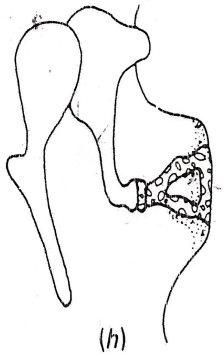
Stapes superstructure absent



(g)

Malleus handle present

Stapes fixed



(h)

Malleus handle absent

Stapes fixed

In 1971, Austin presented his classification of the anatomical defects found in the ossicular chain in cases of suppurative otitis media. Isolated loss of malleus handle and isolated loss of the stapes superstructure were not classified because of their rarity. In all other cases the incus was deficient either totally or in part and four types of ossicular defects were therefore described depending on the presence or absence of the malleus handle and the presence or absence of the stapes superstructure.

AUSTIN'S CLASSIFICATION OF OSSICULAR CHAIN DEFECTS

1. Malleus handle present, stapes superstructure present
2. Malleus handle absent, stapes superstructure present
3. Malleus handle present, stapes superstructure absent
4. Malleus handle absent, stapes superstructure absent

RARE DEFECTS :

1. Isolated loss of the malleus handle
2. Isolated loss of the stapes
3. Malleus handle present and stapes fixed
4. Maleus handle absent and stapes fixed.

OSSICULO PLASTY

Its an operation performed to repair or reconstruct the ossicular chain.

History :

In 1952, Wullstein was the first to use a bio material in reconstructive middle ear surgery. He implanted a columella of palavit in the middle ear for the reconstruction of middle ear chain. Although the initial hearing results were good, the implant extruded.

Hall and Rytzner (1957) performed the first ossicular chain reconstruction using Autogenous ossicular bone.

Bell (1958) - When the long process of incus was missing he removed incus and transposed the malleus attached to the tympanic by its umbo on to stapes side. Similar transposition were described by Farrior (1960) Portman (1963). The usefulness of autologous ossicular bone grafts in tympanoplasty was challenged by Iongkees (1957). He reported histological evidence of infection in 92% of incus and malleus bones removed. He emphasized that the use of these diseased autologous ossicles in tympanoplasty may prejudice the results of reconstruction.

1966, House, Patterson and Linthicum (1966) introduced incus allograft.

In 1970s, the idea of alloplastic Prostheses came. High density poly ethylene sponge (HDPS) were introduced. From them Partial Ossicular Replacement Prostheses (PORP) and Total Ossicular Replacement Prostheses (TORP) were developed. Later thermal fused high density polyethylene sponge was also developed.

In 1979, ceramic were introduced, it consists of bio inert and bio active types. Reck and Hellms described the use of bio active glass ceramic called ceravital.

Maisin, Munting and Gersdorff (1989) have used cadaver acquired human long bone defatted in 1:1 methanol - chloroform, decalcified in 0.6 M HCl solution and lyophilized, for ossiculoplasty.

In 1996, HAPEX introduced. This involved the attachment of hydroxylapatite reinforced polyethylene composing cuff or shaft to the dense hydroxylapatite. It is a homogenous osteoconductive bio material that is composed of 40% hydroxylapatite and 60% of polyethylene. This material approximates the mechanical strength of bone yet it is soft enough to be cut with a knife.

Four types of graft can be defined according to the genetic relationship between the donor and the host .

TRANSPLANT TERMINOLOGY

Old Terminology	New Terminology	Definition
Autograft	Autograft	Tissue transplanted from one part of the body to another in the same individual.
Isograft	Isograft	Tissue transplanted between genetically identical individuals.
Homograft	Allograft	Tissue transplanted between genetically non – identical members of the same species
Heterograft	Xerograft	Tissue transplanted between members of different species.

Grafts of any genetic origin may be further defined according to their new anatomical site, pattern of vascularization and functional capacity.

- ✓ Orthotopic graft
- ✓ Heterotopic graft
- ✓ Vascularized grat
- ✓ Non vascularized graft
- ✓ Vital graft
- ✓ Static graft

Orthotopic Graft :

Grafts placed in an anatomical position normally occupied by such tissue are orthotopic grafts. e.g. A tympano-ossicular allograft used to reconstruct the tympanic membrane and ossicular chain.

Heterotopic Graft :

Those grafts placed in an unnatural recipient location. e.g. a sculptured nasal septal cartilage allograft used to reconstruct the ossicular chain or outer attic wall.

Vascularized Graft :

A graft placed directly onto a vascular pedicle. e.g. Kidney transplant.

Non Vascularized Graft :

Vascularizes indirectly form the receipient bed. eg. A preserved dura mater graft used to repair the tympanic membrane.

Vital Graft :

Those grafts expected or intended to fulfil their normal physiological functional capacity. e.g. Kidney transplant.

Static Graft :

Serve a mechanical function that does not require physiological viability. Such grafts act as a scaffolding or matrix onto, and into, which host tissues extend. At present, all tissue grafts used in tympanoplasty are free, non-vascularized static grafts.

Bio material used in otology can be conveniently and broadly subdivided into

- ❖ Bio inert
- ❖ Bio tolerant
- ❖ Bio reactive
- ❖ Bio active

❖ **Bio inert**

Body does not react at all with the implant material

❖ **Bio tolerant**

Body regards the implant material as a foreign body but does not extrude the implant.

❖ **Bio Reactive :**

These ceramics will bond with bone. Calcium and phosphate ions found in the interface between the ceramic and bone are thought to be derived principally from the ceramic itself.

❖ **Bio active**

If the body has an active surface integration with the implant material which leads to firm integration between the body and implant.

BIO CERAMICS USED IN OSSICULOPLASTY

Product	Appearance	Prostheses
Bio inert		
Frailit	Dense white	PORP / TORP
Bioceram	Dense white	CORP – P / CORP –T
Macor	Dense white	PORP / TORP
Bio reactive		
Bio glass	Dense transparent	PORP / TORP
Ceravital	Dense white	PORP / TORP
Bio active		
Hydroxlapatite	Dense white	PORP / TORP

BIO TOLERANT BIO MATERIAL

Metals	Polymer
Stainless steel	* **Solid**
Tantalum	Polyethylene
Platinum	Teflon
Titanium	Silastic
	*** Porous**
	Polytetrafluoroethylene – carbon fibre composite (Proplast – 1)
	Polytetrafluoroethylene–aluminiumoxide composite (Proplast – 2)
	High density polyethylene (Plastipore)
	Ultra-high molecular weight polyethylene (Polycel)
	Light Harness satin-weave carbon fibre impregnated with phenolic resin (Carbon-carbon)

Preservation techniques for Otological allografts

- 70% Ethyl Alcohol
- 0.02% Aqueous cialit, (sodium 2-ethyl mercurithio benzeoxazole -5 carboxylate)
- 4% Buffered formaldehyde fixation and 0.5% buffered formaldehyde preservation
- 4% Buffered formaldehyde fixation and 0.02% aqueous Cialit preservation
- 0.5% Buffered glutaraldehyde fixation and 0.02% aqueous Clalit preservation
- Freeze drying and ethylene oxide gas sterilization
- 4% Buffered formaldehyde fixation followed by freeze drying and ethylene oxide gas sterilization.

Requirement of Ideal Prostheses for Ossiculoplasty :

- Durable
- Bio compatible
- Easy to manipulate
- Good hearing improvement

The most reliable way to perform an ossicular plasty is to reconstruct the defect in ossicular chain in such a way that the ossicular chain is moved via the tympanic membrane by its contact with the handle of malleus and that the lever mechanism of ossicular chain is a part of the transmission making proper piston like function possible.

Depending on the timing of reconstruction ossiculoplasty is divided in to

- ❖ Primary
- ❖ Secondary stage

- ❖ **Primary:**

Requirement for primary ossiculoplasty

- o Presence of normal or hypertrophied mucosa
- o Patent Eustachian tube
- o Mobile stapes foot plate

- ❖ **Secondary Stage:**

- o When middle ear mucosa is completely removed
- o Stapes foot plate fixed.

Four possibilities of ossicular chain erosion are

M+	SS +	I –
M+	SS -	I –
M-	SS +	I –
M-	SS-	I –

The function of columella in the reconstruction of the ossicular chain depends on a good conduct with the foot plate or stapes supra structure as well as on the large surface area of tympanic membrane.

Based on this two types of reconstruction are there :

- Short columella
- Long columella

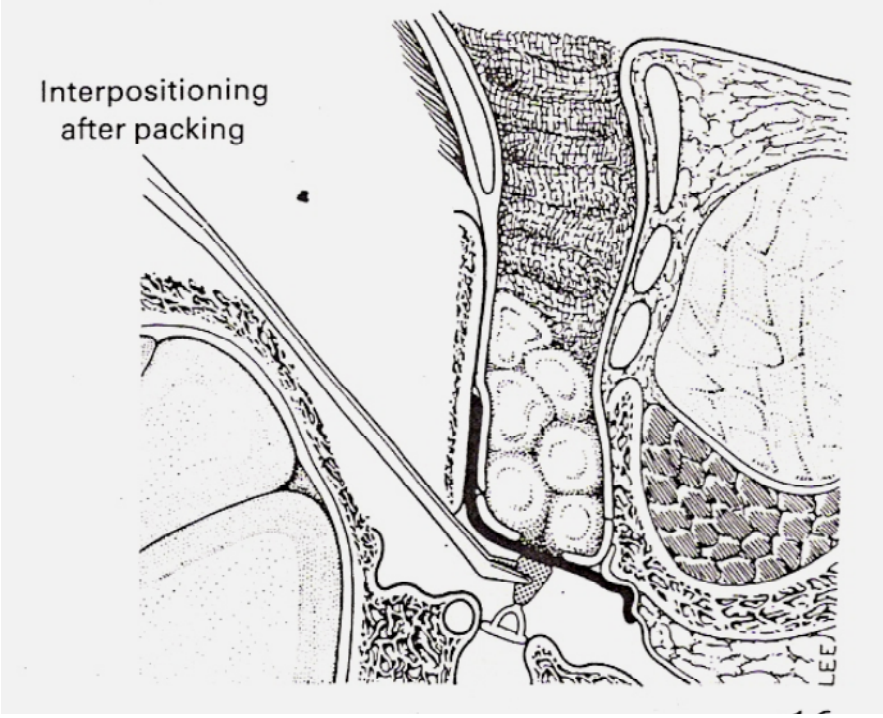
Short Columella :

It consists of two types

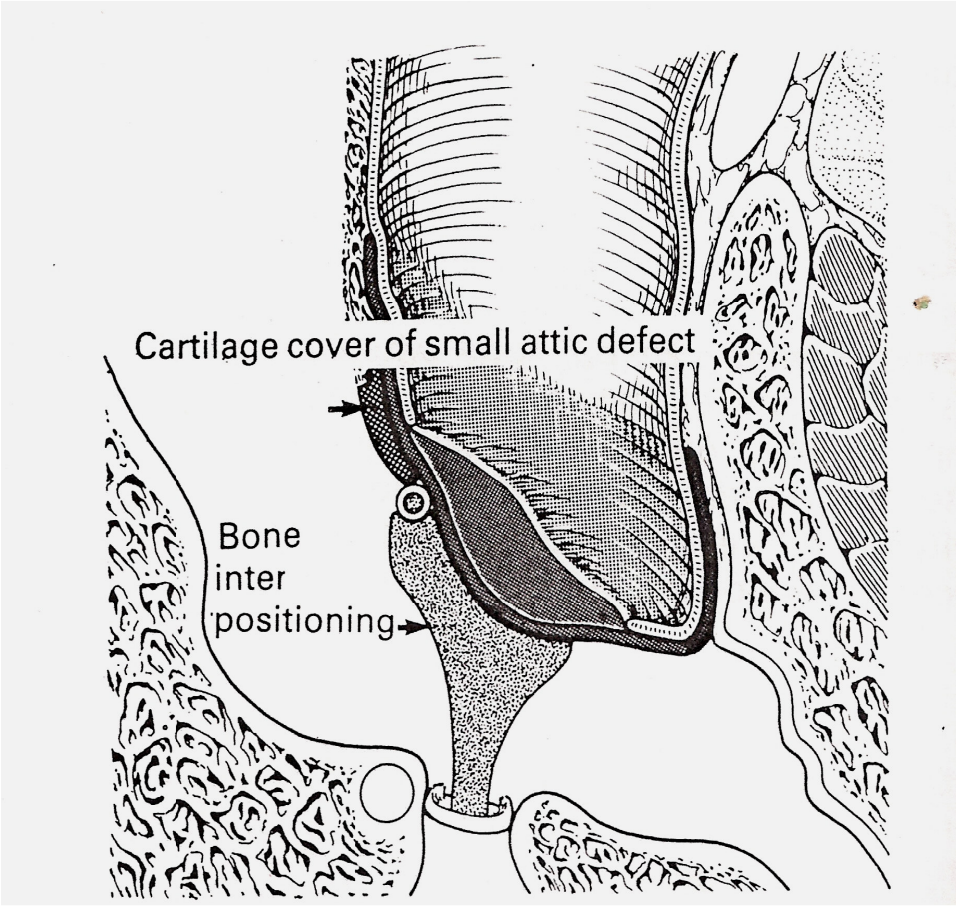
- Myringo malleo stapedopexy
- Myringo stapedopexy

MYRINGO MALLEO STAPEDOPEXY

MYRINGO STAPEDOPEXY



MYRINGO PLATINO PEXY



Myringo malleo stapedopexy :

M + I - SS +

This procedure is done when malleus and stapes supra structure are intact and incus eroded. Ossicle graft is positioned between malleus and stapes supra structure

Myringo stapedopexy

M - I - SS +

This procedure is done when malleus and incus are eroded. Eroded malleus and incus are removed ossicle graft placed over stapes suprastructure and newly placed temporalis fascia graft.

Long columella :

Myringo platino pexy

M - I - SS –

When malleus incus and stapes supra structures are eroded and stapes foot plate only is present ossicle graft is placed between foot plate of stapes and temporalis fascia graft.

MERI - Middle ear risk index :

This is a more practical protocol developed by Kartush, generates numeric indicator of the severity of middle ear. It helps in the preoperative evaluation of patient selected for ossiculoplasty.

Middle Ear Risk Index (MERI)

Risk Factor	**Risk value**	**Assigned Risk**
i) Dry	0	
ii) Occasionally wet	1	
iii) Persistently wet	2	
iv) Wet cleft palate	3	

Perforation		
Absent	0	
Present	1	

Cholesteatoma		
Absent	0	
Present	1	

Ossicular status (Austin/ kartush)		
0 : M + I + S+	0	
A : M+ S+	1	
B : M+ S-	2	
C : M - S+	3	
D : M- S-	4	
E : Ossicle head fixation	2	
F : Stapes fixation	3	

Middle ear : granulations or effusion

No	0
Yes	1

Previous Surgery

None	0
Staged	1
Revision	2

Total MERI

Risk categories can be classified from MERI as follows.

MERI	-	0	Normal
		1-3	Mild
		4-6	Moderate
		7 -12	Severe

Hearing Results :

For reporting hearing results, the following guidelines for air bone closure have been recommended.

0-10	Excellent
10-20	Good
20-30	Fair
> 30	Poor

MATERIALS AND METHODS

With the kind permission of HOD of forensic medicine, Dean of our college, we obtain femoral bone of length around 10 cm from a fresh cadaver.

We divided the bone into small pieces of size of approximate 8 x 3mm which are again shape to short and long columella. The prepared ossicles are stored in 70 % alcohol. Advantage of storing in 70% alcohol are one, it kills micro organisms and second one is, it reduces antigenicity.

We selected 20 cases of CSOM underwent mastoidectomy for ossicular reconstruction.

The procedures we employed for reconstruction are

1. Myringostapedopexy (Short columella)
2. Myringoplatinopexy (Long columella)

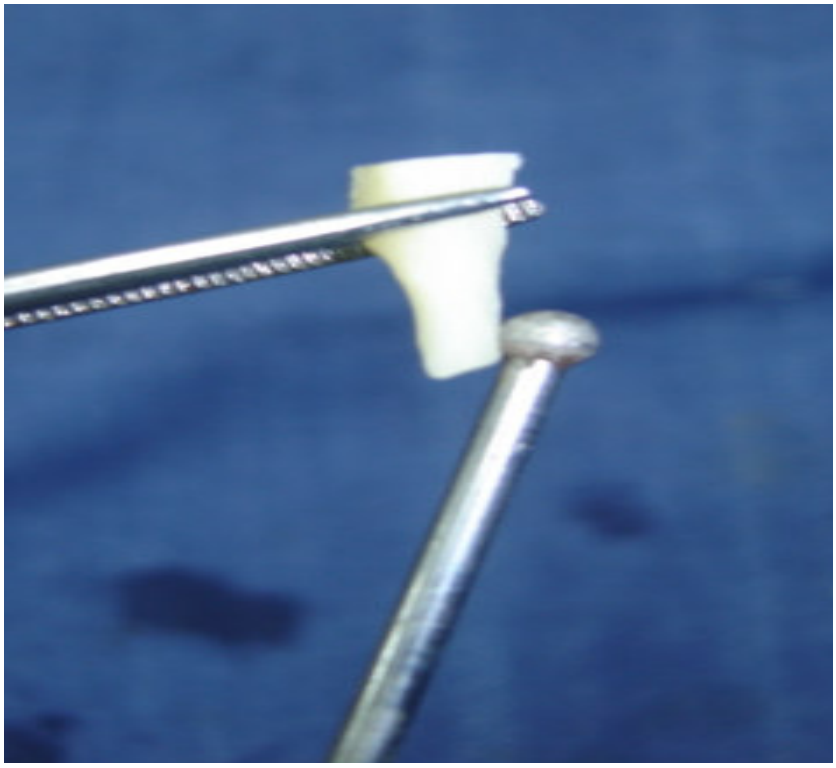
CORTICAL HOMOGRAFT OSSICLES

IN 70% ALCOHOL

SHAPING CORTICAL

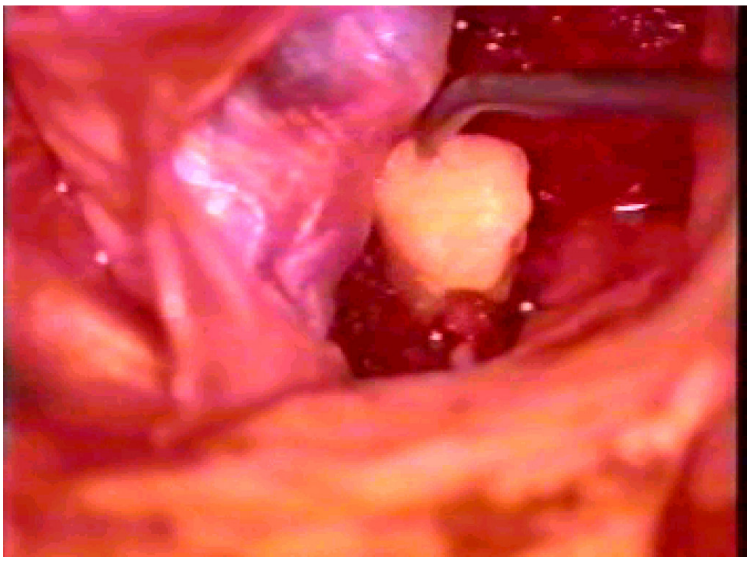
HOMOGRAFT OSSICLE

`



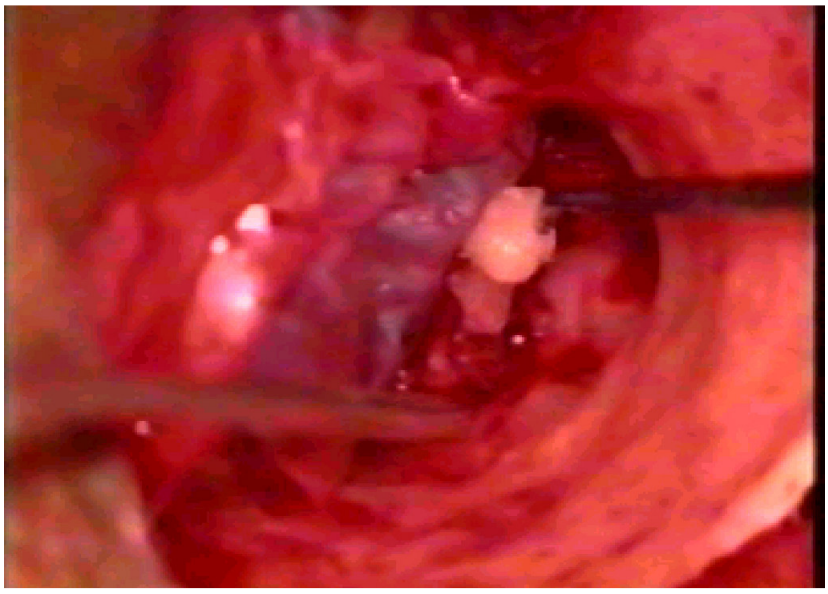
SHORT COLUMELLA OSSICLE

MYRINGOSTAPEDOPEXY



LONG COLUMELLA OSSICLE

MYRINGOPLATINOPEXY



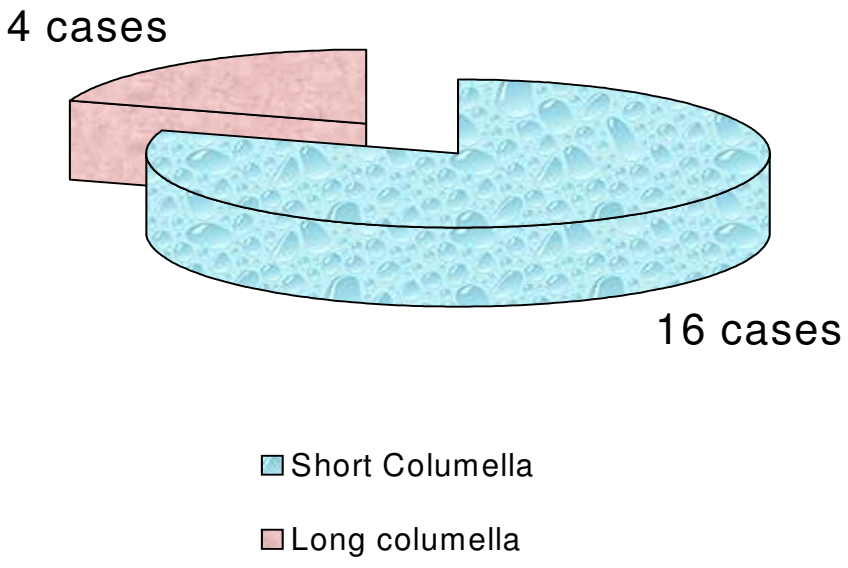
Myringostpedopexy :

In 16 cases we employed this method. Eroded long process of incus is removed. The shaped femoral cortical homograft ossicle placed between stapes suprastructure and newly placed temporalis facia graft. For preventing post operative adhesion small piece of fibro periosteal tissue placed over the posterior canal wall.

Myringoplatinopexy :

In 4 cases, we employed this method. Eroded long process of incus, malleus and stapes supra structure are removed. Small piece of temparolis fascia graft placed over the mobile stapes foot plate. The shaped homograft ossicle is placed between the mobile foot plate of stapes and temporalis fascia graft. Gelfoam placed around the graft ossicle.

PROCEDURES



Post operative Follow up :

Mastoid dressing removed after one week. Canal pack removed after three weeks and microscopic cleaning done after removal of canal pack. Post operative audiogram for all cases taken after 3 months. Regular follow up was done every 6^{th}, 9^{th} and 12^{th} month. In one of the case we reopen ,the ossicle subjected for pathological examination. We found that there was no resorbtion of ossicle graft.

Complications:

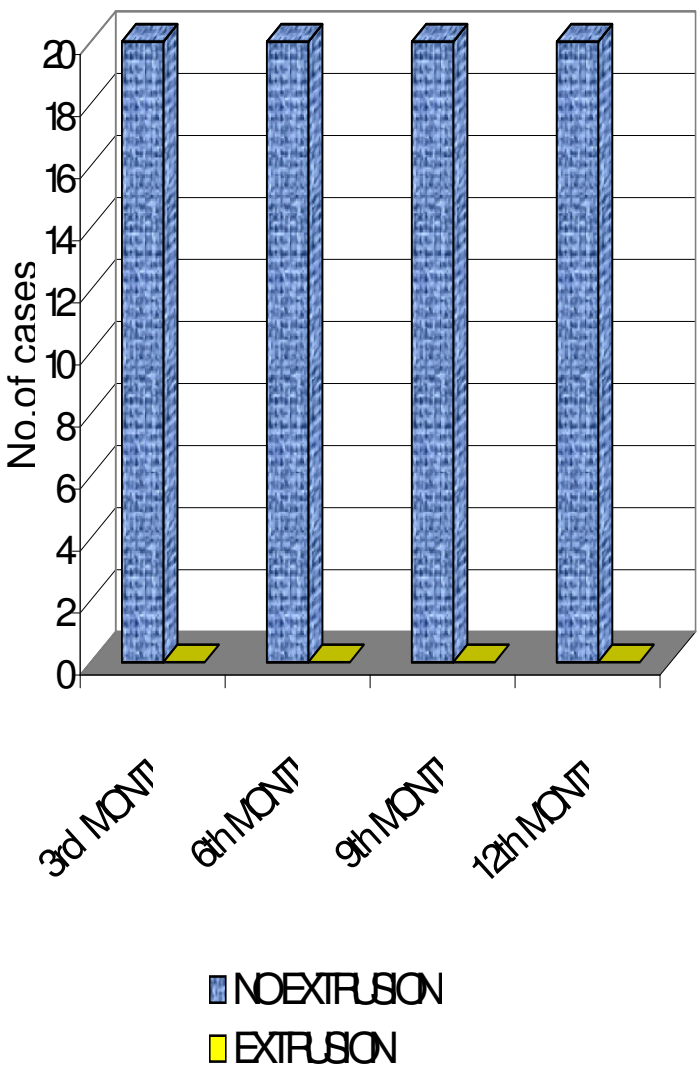
No serious complications have been encountered so far in our surgeries. Immediate post operative complications of vertigo are seen in three cases but subsided on its own.

DISCUSSION

An important principle in successful ossicular reconstruction is obtaining a mucosa lined air containing middle ear space.

Using today technology including operating microscope, microsurgical instruments and varieties of prosthetic material it is possible to improve hearing in the majority of the patients undergoing ossicular reconstruction. However, restoration of normal hearing is unusual. Significant variables in ossicular reconstruction which influences the outcome are - function of Eustachian tube, middle ear mucosa, tympanic membrane condition, status of ossicular chain and prosthetic materials used for reconstruction.

In the past very many bioactive, bio inert, materials were used for ossicular reconstruction with varying results. Long term follow up for the past 40 year found that homo and auto graft ossicles are having excellent biocompatibility, stability, low extrusion rate and no resorption.

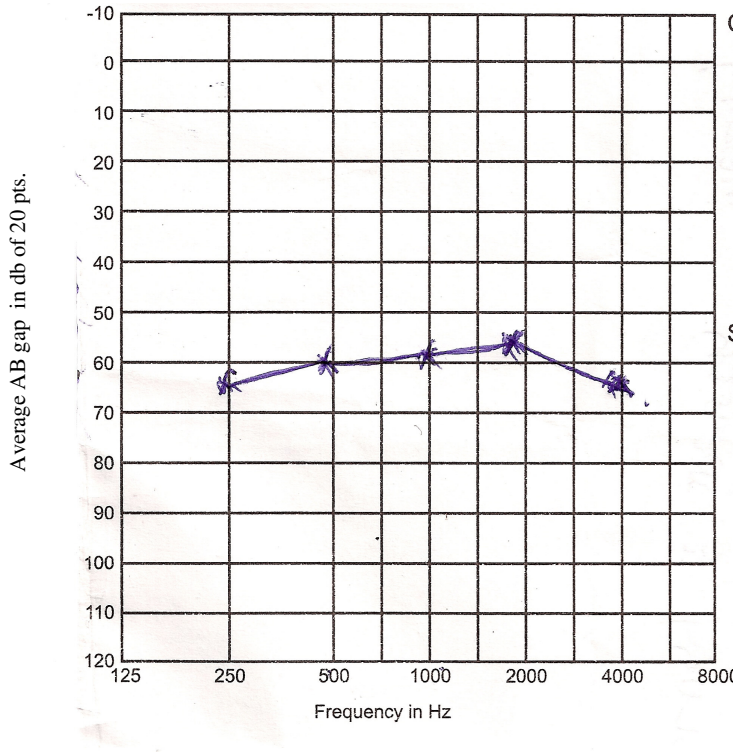

Stability of osside graft
No. of cases
20
18
16
14
12
10
8
6
4
2
0
3rd MONTH
6th MONTH
9th MONTH
12th MONTH
NO EXTRUSION
EXTRUSION

Department of ENT
Government Rajaji Hospital,
Madurai

PURE TONE AUDIOGRAM

Patient Name : Date :

Address : Age / Sex :



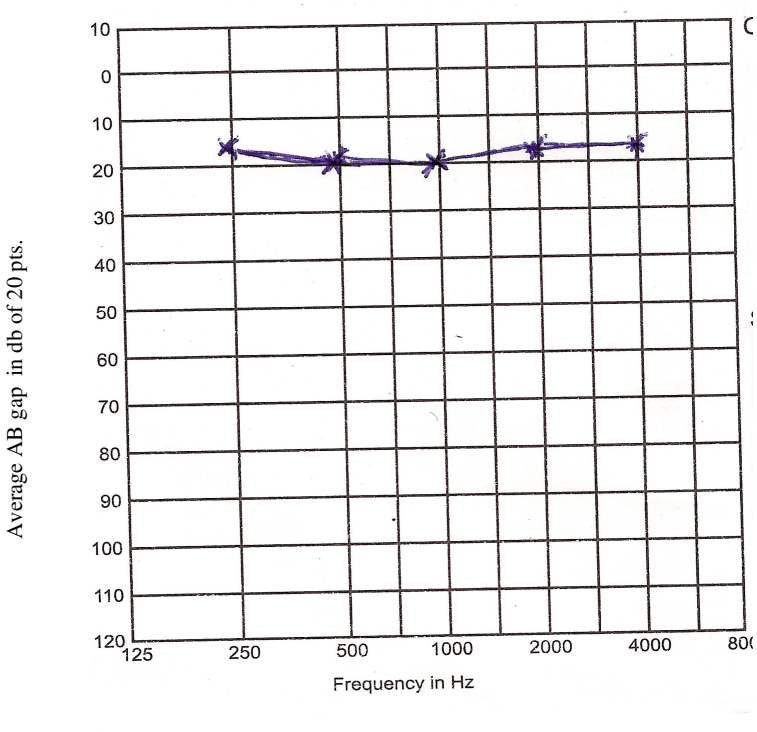
Preoperative Audiogram

Department of ENT
Government Rajaji Hospital,
Madurai

PURE TONE AUDIOGRAM

Patient Name : Date :

Address : Age / Sex :



Postoperative Audiogram

At this juncture we used cortical bone homograft for ossicular reconstruction. Its easy to prepare number of ossicle graft from small piece of bone. They are easy to store and they are easy to manipulate. Required length of ossicle can be easily prepared.

Results were analyzed by

- Stability of the graft
- Hearing improvement

Stability

In our study of 20 cases, we found that extrusion of ossicle graft is none, though we follow the patient for 12 months. Long term follow up is necessary.

Hearing Improvement :

More over hearing improvement is good with average AB closure is around 20 db. So, use of cortical bone homograft is very good alternate for alloplastic Prostheses. In future cortical bone homograft ossicle is going to be in all ear bank.

SUMMARY & CONCLUSION

SUMMARY & CONCLUSION

- This study of ossicular reconstruction was conducted in our ENT Department, GRH, Madurai in twenty case of CSOM.

- We found femoral cortical bone homograft is having very good stability.

- Hearing improvement is good with femoral cortical bone homograft.

BIBLIOGRAPHY

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1. Adkins, W.Y. (1990) Composite autograft for tympanoplasty and tympanomastoid surgery. Laryngoscope, 100, 244-247.
2. Armstrong, B.W. (1969) Experience with the ossicular chain. Annals of Otology, Rhinology and laryngology, 78, 939-949.
3. Austin, D.F. (1971) Ossicular reconstruction. Archives of Otolaryngology, 94, 525-535.
4. Austin, D.F. (1982) Avoiding failures in the restoration of hearing with ossiculoplasty and biocompatible implants. Otolaryngologic Clinics of North America, 4, 763-771.
5. Austin, D.F. (1985) Columellar tympanoplasty. American Journal of Otology, 6, 464-467.
6. Bauer, M. (1966) Bone autograft for ossicular reconstruction. Archives of Otolaryngology, 83, 335-338.
7. Bell, H.L. (1958) A technique of tympanoplasty (tympanomaller stapediopexy). Transactions of the

American Laryngological, Rhinological and Otolaryngological Society, 572-576.

8. Benitex, J.T Bejar, I.R. and Mcintire C.L. (1971) Ossiculoplasty experimental studies of cortical bone grafts for replacement of the incus in cats. Journal of laryngoogy and Otology, 85, 1177-1182.

9. Betow, C. (1982) 20 years of experience with homografts in ear surgery. Journal of Laryngology and Otology, suppl 5.

10. Brockman, S.J. (1965) Cartilage graft tympanoplasty Type III, Laryngoscope, 75, 1452-1461.

11. Campell, E.E. (1990) Homograft tympanoplasty : a long term review of 477 ears. American Journal of Otology, 11, 66-70.

12. Chandler, J.R. (1965) The incus in tympanoplasty, Laryngoscope, 75, 793-804.

13. Chiossone, E. (1977) The establishment of an ear bank. Otolaryngologic clinics of North America, 10, 599-612.

14. English, G.M., Hildyard, V.H. Hemenway, W.G. and Davidson, S. (1971) Autograft and homograft incus

transplantations in chronic otitis media. Laryngoscope, 81, 1434-1447.

15. Farrior, J.B. (1960) Ossicular repositioning and ossicular prostheses in tympanoplasty. Archives of Otolaryngology, 71, 443-449.

16. Farrior, J.B (1966) Principles of surgery in tympanoplasty and mastoidectomy. Laryngoscope, 76, 816-841

17. Erootko, N.J. (1984) Allograft rejection in the middle ear of the rat. MSc. Thesis, University of Oxford.

18. Frootko, N.J. (1985b) Immune responses in allograft tympanoplasty. In : Immunobiology, Auto immunity and Transplantation in Otorhinolaryngology, edited by J.E. Veldman, B.F. McCabe, E. Huizing and N. Mygind. Amsterdam / Berkeley : Kugler Publications, pp. 171-176.

19. Frootko, N.J. (1987) Immune responses in allograft tympanoplasty. In : Otoimmunology, edited by J.E. Veldman and B.F. McCabe. Amsterdam / Berkeley : Kugler Publications. Pp, 119-124.

20. Glasscock, M.E and House, W.F. (1968) Homograft reconstruction of the middle ear, Laryngoscope, 78, 1219-1225

21. Glasscock, M.E., House W.F. and Graham, M. (1972). Homograft transplants to the middle ear. A follow up report. Laryngoscope, 82, 868-881.

22. Goodman, W.S. (1980) Tympanoplasty – 25 years later, Journal of Otolaryngology, 9, 155-168.

23. Grippaudo,M. (1958) Histopathological studies of the ossicles in chronic otitis media. Journal of Laryngology and Otology, 72, 177-189.

24. Grote, J.I. (1984a) Biomaterials in Otology. Proceedings of The First International Symposium, 1983. Leiden, The Netherlands : Martinus Nijhoff Publishers.

25. Guilford, F.R. (1965) Repositioning of the incus. Laryngoscope, 75, 236-242.

26. Hall, A, and Rytzner, C (1960) Vitality of autotransplanted ossicles. Acta Otolarynogologica Supplementum, 158, 335-340.

27. House, W.F. Patterson, M.E and Linthicum, F.H. (1966) Incus homografts inchronic ear surgery. Archives of otolaryngology, 84, 148-153.

28. Marquet, J, (1976b) Ten years experience in tympanoplasty using homologous implants. Journal of Laryngology and Otology, 90, 897-905

29. Marquet j.(1977) Twelve years experience with homograft tympanoplasty. Otolaryngologic clinics of North America, 581-593.

30. Morrison,A.W. (1970) Homograft tympanoplasty and myringoplasty. Acta Oto-Laryngologica (Belgica), 24, 45-52.

31. Ojala, K., Sorri, M., Vainio-Matilla, J. and Sipila, P. (1983) Late results of tympanoplasty using ossicle or cortical bone, Journal of Laryngology and Otology, 97, 19-25.

32. Perkins, R. (1970a) Human homograft otologic tissue transplantation. Buffered formaldehyde preparation. Transactions of the American Academy of ophthalmology and Otolaryngology, 74, 278-282.

33. Pulec, J. L. and Sheehy, J.L. (1973) Tympanoplasty : Ossicular chain reconstruction. Laryngoscope, 83, 448-465.

34. Sheehy, J.L. (1965) Ossicular problems in tympanoplasty. Archives of Otolaryngology, 81, 115-122.

35. Smith, M.F. W. (1980b) Allograft ossicular chain transplantation. In : Controversy in Otolaryngology, edited by J.B. Snow, London : W.B. Saunders & Co. pp. 178-183.

36. Smith, M.F.W. and Dobie,R. (1976) The use of homograft stapes. Laryngoscope, 86, 1196-1202.

37. Smyth G. D.L. and Kerr, A.G., (1967) Homologous grafts for ossicular reconstruction in tympanoplasty. Laryngoscope, 77, 330-336.

38. Szpunar, J. (1969) Autografts of the ossicular chain. Proceedings of the Ninth International Congresss of Otorhino – laryngology. Mexico, 1969. Amsterdam : Excerpta Medica. Pp. 147-150.

39. Tos, M, (1978) Allograft stapes – incus assembly. A new ossiculoplasty. Archives of Otolaryngology, 104, 119-121.

40. Wehrs, R.E., (1967) The borrowed ossicle in tympanoplasty, Archives of Otolaryngology, 85, 371-379.

41. Zollner, F. (1969) Round table on ossicular autografts and homografts. Archives of Otolaryngology, 89, 230.

MASTER CHART

MASTER CHART

S.No	Name	Age	Sex	I.P.No.	Diagnosis	Procedure
1.	Kannan	25	M	330728	CSOM – L	SC
2	Muthupandy	30	M	345158	CSOM - R	SC
3	Saraswathy	45	F	240327	CSOM – B	SC
4	Vadivel	21	M	348717	CSOM – L	SC
5	Dhanalakshmi	18	F	362274	CSOM – L	LC
6	Shak	15	M	356302	CSOM – R	SC
7	Rajan	20	M	367995	CSOM – L	SC
8	Nagarajan	20	M	368760	CSOM – L	SC
9	Jothilakshmi	15	F	371058	CSOM – L	SC
10	Prabhu	22	M	375107	CSOM – L	SC
11	Kalaivendran	16	M	378836	CSOM – B	LC
12	Ramesh	29	M	381345	CSOM – L	SC
13	Indhira	38	F	391102	CSOM – L	SC
14	Sudha	16	F	391443	CSOM – R	SC
15	Ramesh	19	M	393581	CSOM – L	LC

16	Uma	22	F	393996	CSOM – R	SC
17	Lakshmi	22	F	395690	CSOM – L	SC
18	Kumaran	23	M	39612	CSOM – B	SC
19	Karuppasamy	35	M	396451	CSOM – R	SC
20	Shanmuganathan	45	M	397211	CSOM – L	LC

Abb :

CSOM - Chronic suppurative Otitis Media

SC - Short columella

LC - Long columella